

EXHIBIT I

PRELIMINARY MARS SCIENCE LABORATORY (MSL)
“HIGH FLOW” HELIUM PRESSURE REGULATOR (HFR) GOALS

I. Preliminary Mission Scenario:

The total active mission for the regulator is anticipated to be less than 30 minutes during the spacecraft Entry, Descent and Landing on Mars. The spacecraft is launched and spends seven months on course to Mars, during which time the regulator is inactive and at nominal ambient temperature. The current goal is for the upstream and downstream sides of the regulator to be pressurized to 600 psia and exposed to hydrazine vapors. An upstream pyrotechnic isolation valve is opened during the Mars atmosphere entry, with the goal of pressurizing the regulator to 5000 psia. The Helium tank pressure and temperature decrease with pressurant flow resulting in a Helium temperature of approximately –105 deg C at the end of the mission.

Shortly after pressurizing the regulator, 1 to 30 minutes, six monopropellant hydrazine engines are activated at approximately 170 lbf each (total hydrazine flow about 5 lbm / sec). Two (2) seconds later, all six engines are throttled up to (potentially) 700 lbf each (total hydrazine flow 20 lbm / sec). The mission scenario for the next 60 to 90 sec. is currently subject to many changes. It will involve a period (on the order of 20 sec) of fairly high thrust (flow) operation, followed by a period (approximately 10 sec) at relatively low thrust (total flow greater than 5 lbm / sec). Thrust (flow) will then increase and continue to propellant depletion. There are NO regulator requirements beyond this time (i.e. NO lockup at cold temperature).

II. Performance Goals

The following table presents a preliminary estimate of the HFR Performance Goals.

Table 1. MSL High Flow Regulator Goals.

Subject	Goal
Fluids	Operation: <i>GHe, GN2</i> Testing/Installation: <i>IPA, Water, Argon, Hydrogen Peroxide (external only)</i> Compatibility: <i>Hydrazine</i>
Inlet Pressure	900 psia to 5000 psia
Outlet Regulated Pressure	600 psia

CONTRACT # SPECIMEN
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Maximum Lockup Pressure	635 psia
Proof Pressure	9375 psig at Inlet 900 psig at Outlet
Burst Pressure	15,000 psig at Inlet 1500 psig at Outlet
Flow rate	0 to 0.22 lbm/sec GHe @ -105 deg C and inlet pressures above
Temperature Range	-105 deg C to 60 deg C *
External Leakage	1×10^{-6} sccs GHe max
Internal Leakage	500 scch
Slam Start	Initial Inlet and Outlet Pressures = 250 psia Downstream Volume > 1100 in ³ Outlet pressure shall not exceed 630 psia
Stability	+/- 6 psia max with flow rates between 0.04 lbm/sec and 0.22 lbm/sec
Service Life	5 year Earth storage, 2 years post launch operational life
Cycle Life	30 slam starts 500 cycles (cycle = 2 seconds of operation with flow from 0 to 0.22 lbm/sec)

* Cold temperature is due to the expansion of the Helium. Pressure regulation goals apply at cold temperature BUT there will be NO lockup goals when cold.

Testing

Testing will be based upon the contractors proposal for component level and system level tests. At a minimum: a high pressure Helium tank having a volume of 7200 cubic inches (TBR) which supplies the HFR and regulated pressure liquid (water) outflow from a receiver tank shall be demonstrated at flow rates of 5 to 20 lbm/sec water during testing.